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Parents' Observations of the Academic and Nonacademic Performance of Children with Strabismus

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Abstract: In this study, children with strabismus, as a group, had significantly more academic and nonacademic difficulties than did children without strabismus. However, since not all the children with strabismus had academic difficulties, other factors that are associated with strabismus, such as headache, eyestrain, perceptual difficulties, and frustration, may affect learning in some children with strabismus.

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The impact of strabismus on students' school performance is not well established. One source of such information is parents' reports. Some studies have shown that parents' observations of their children's academic skills are similar to teachers' or professionals' observations (Cassidy, 1976; Diamond & Squires,

1993; Gianatasio, 2001) and are consistent with standardized tests (Dewey, Crawford, Creighton, & Sauve, 2000; Diamond, 1987; Glascoe, 1997, 2001). Researchers have also asked parents to identify visual dysfunction and areas in which this dysfunction has an effect on the children. Rosner and Rosner (1988) found that parents accurately identified strabismus in their children, and Kliman and Vukelich (1985) noted that parents of children with early-onset strabismus more often suspected a visual problem than did parents of children with later-onset strabismus. In addition, parents perceive that their children's school performance is affected by strabismus (Eustis & Smith, 1987, 1988; Kliman & Vukelich, 1985). Although parents' observations of their children's school performance are generally accurate, the cause of this poor performance may be unrelated to the children's visual status.

Snowden and Stewart-Brown (1997) studied the impact of visual difficulties on school performance and concluded that the quality of literature linking visual deficits to learning deficits is insufficient to offer strong predictions of school performance. However, some studies have found a relationship between visual deficits and difficulties in reading (see, for example, Alberman, Butler, & Gardiner, 1971; Farrag, Khedr, & Abel-Naser, 2002; Gompel, Janssen, van Bon, & Schreuder, 2003; Lehmkuhle, Garzia, Turner, Hash, & Baro, 1993; Lovegrove et al., 1982; Martin & Lovegrove, 1984; Romani et al., 2001) and between

visual deficits and attention (Tonge, Lipton, & Crawford, 1984). Woodhouse, Griffiths, and Gelding (2000) reported that 22.8% of their sample of children with learning disabilities had strabismus, compared to 4%–6% of children in the general population (Ontario Association of Optometrists, 1997; Tonge et al., 1984). Furthermore, Snowden and Stewart-Brown (1997) concluded, from a comparison of studies, that strabismus may be associated with reading and copying difficulties.

Some researchers have suggested that strabismus is also associated with some nonacademic difficulties (for example, motor-coordination difficulties and stumbling). Rogers, Chazan, Fellows, and Tsou (1982) examined cases of congenital esotropia and noted deficits in motor skills and visually guided tasks, such as reaching and grasping. Furthermore, children with strabismus are often categorized as clumsy (Alberman et al., 1971) and have difficulty with eye–hand coordination (Fronius & Siretaneu, 1994).

Although some studies have established possible links between strabismus and both academic and nonacademic difficulties, it is not clear what proportion of children with strabismus have such difficulties. It is also possible that other associated factors, not strabismus, are the root of these difficulties. In this article, we compare, through a survey of parents, the academic and nonacademic difficulties of children with strabismus and of a control group of children without

strabismus. An examination of both academic and nonacademic difficulties, based on parents' observations, may contribute to a better understanding of the impact of strabismus on everyday learning.

Method

Participants

Parents of children with strabismus

The participants were the parents of 137 children with strabismus aged 6–16. All the children had been treated for strabismus at the Hospital for Sick Children's strabismus clinic in Toronto. File reviews of the children's clinical histories at the hospital were used to determine which parents would be included before the parents were contacted by mail, and the characteristics of the children with strabismus in the final sample. The age at which strabismus was diagnosed in these children ranged from months/infantile (recorded as congenital) to 5.9 years. Strabismus was diagnosed within the first year of life in 71 children (51.8%) and after the first year in 63 children (46%); the age at diagnosis of the remaining 3 children was not reported.

Data on the children's visual histories from hospital files were collected and reported for children during their elementary school years (aged 6–9). Of the 137 children, 90 were classified as having esotropia, and 37 were classified as having exotropia. In 10 children, the

size, but not the direction, of the strabismic deviation was indicated in their medical histories. During the elementary school years, the angle of strabismic deviation in the deviating eyes varied from no residual strabismus (in some postsurgery/treatment cases) to 45 prism diopters. Eighty-two children (59.9%) had surgical correction of strabismus prior to the elementary school years. Residual strabismus of greater than 10 diopters was reported in 33 of these children.

During the elementary school years, spherical equivalent refractive errors ranged from –4.25 diopters to +9.25 diopters. Forty-five children had hyperopia of greater than 2.5 diopters. In 48 children, orthoptic reports indicated the suppression of the strabismic eye, and in all cases, strabismus was classified as constant (intermittent cases were excluded from this sample). Linear acuities in nondeviating eyes were within normal limits (that is, equal to or better than 20/25), except for 19 children with 20/30 and 1 child with 20/40. Acuity in the deviating eyes was within normal limits in 83 children. Thirty-one children had an acuity of 20/30 in the deviating eye, and 23 children had an acuity of 20/40 or less in the deviating eye. In addition, 108 children had been tested for stereo acuity (using the Titmus Stereo Test). Normal or near-normal stereo acuity (40 to 100 seconds) was found in 20 children, and low stereo acuity (140 to 800 seconds) was found in 88. The medical histories of all the children had been taken by attending physicians and pediatric

ophthalmologists. Children whose medical histories indicated other ocular disorders, nystagmus (latent or manifest), medical conditions that might affect vision (such as diabetes), neurological disorders, or developmental delay were excluded from the sample.

Parents of children in the control group

The parents of 50 sighted children without strabismus, ranging in age from 6 to 12 years, participated in the study. These parents were asked to base their judgments of their children's vision on reports from the children's optometrists or ophthalmologists. The children whose parents indicated that their children had vision problems were excluded from the study. All the children in the control group were siblings of those in the group with strabismus. The use of a sibling group allowed us to control for some environmental factors (e. g., school district and home environment).

Design and procedure

The content of the survey was developed through a review of the literature and comments made by parents during other studies. The categories of questions were consistent with standard surveys of parents on children's academic abilities (for example, the Parent Evaluation of Developmental Status, Parent Ratings of Everyday Cognitive and Academic Abilities, and the Child Development Inventory). However, only questions in academic developmental areas were

included, such as parents' opinions of their children's learning-to-read process and other learning difficulties (for example, language and mathematics). In addition, our survey also asked parents about some visually related nonacademic difficulties (for example, headache and eyestrain). Before the survey was finalized, it was pilot-tested on two parents of children with learning difficulties and one pediatric ophthalmologist, to ensure that parents would understand the instructions, wording, and response options. No difficulties in any of these areas were noted. The final survey questionnaire is presented in Box 1.

Once the pilot-testing was completed, the medical-history files of potential participants were reviewed and selected. Selection criteria included children with constant strabismus who did not have nystagmus, neurological conditions, developmental delay, other visual conditions (for example, cataracts), or medical illnesses that affect vision (for example, diabetes). The 17-question survey was then mailed to 287 parents of children who were being treated at the strabismic clinic of the Hospital for Sick Children in Toronto. The surveys were coded so that information on the children's medical histories could be attached to the survey responses, but the names of the children would not be attached. The parents returned the completed surveys to the first author via mail. In total, 137 surveys were returned completed, representing a 48% response rate.

Four types of questions were included in the survey: binary response (yes or no, for example, "Has your child ever had difficulties with reading?"); multiple choice, for which the participant chose from options provided or added options (for example, "What is the basis of your assessment of your child's learning to read abilities? check all that apply"); Likert-type rating questions; and open-ended questions for which the parents could write in their responses.

Data analysis

The data were analyzed in standard fashion from four perspectives. First, for binary questions, the proportion who answered yes or no was assessed. Second, for multiple-choice questions, the proportion who chose each response was assessed (the participants were allowed to choose more than one option). For those who added responses that were not included in the original list, a content analysis (by item) was performed. Third, for rating questions, mean responses and frequencies of response were calculated; and for open-ended questions, a content analysis by theme was conducted. Fourth, these data were split by demographic variables (that is, subject group—those with strabismus or the control group and visual condition) and were compared using inferential statistics (chi-square, *t*-test, confidence interval).

Results

Reading difficulties

The parents were asked whether their children had reading difficulties. To make this judgment, they were directed to base their opinion of their children's ability on a combination of their own observations, interviews with teachers, and their children's report cards. However, eight parents indicated that they based their opinion solely on their own observations, and in six of these cases, the parents reported that their children had no reading difficulties.

As is illustrated in Figure 1 (the top bars), 38% of the parents of the children with strabismus and 22% of the parents of the children in the control group reported that their children had reading difficulties. Although the percentages of children with reading difficulties did not differ significantly between the two groups of children (Yates-corrected chi-square = 3.49, $p > .05$), the parents of the children in the control group more strongly agreed that the learning-to-read process was an easy one for their children than did the parents of the children with strabismus ($t_{183} = 2.21$, $p = .028$).

Since the children in the control group were siblings of 50 children with strabismus, we wondered if it was these siblings with strabismus who were reported to have reading difficulties because of the availability of the direct comparison within the same families. We therefore reanalyzed these data using only the sibling pairs. Similar to the entire sample, we found that 34%

of the siblings with strabismus were reported to have reading difficulties. In addition, we found a nonsignificant trend that suggested that it was easier for the children in the control group to learn to read than it was for their siblings with strabismus ($t_{49} = 1.23$, $p > .05$).

Table 1 shows the percentage of children with strabismus whose parents reported that they had reading difficulties compared to the percentage of children with strabismus whose parents reported that they had no reading difficulties, by visual conditions. As the table illustrates, there were no significant differences between these groups in the percentage of children who wore and cooperated with wearing eyeglasses or who wore and cooperated with wearing eye patches during the first to fourth grade in school (confidence interval, C_{95}, $p > .05$). In addition, those with reading difficulties were no more likely to have high hyperopia, low acuity, low stereo acuity, early-onset strabismus, exotropia, suppression of vision to one eye, or a larger angle deviation than were those with no reading difficulties (C_{95}, $p > .05$). All the parents of children with strabismus who reported that their children had reading difficulties noted that the difficulties began in the elementary school years. In addition, 41% of the parents whose children were no longer in elementary school reported that reading difficulties persisted into secondary school.

As we noted in the Method section, 83 children with strabismus had typical acuity in both eyes. To examine the possibility that low acuity contributed in a significant way to our observations of reading difficulties, we examined data for these 83 children alone. Overall, we found that 35% of the children with strabismus who had typical acuity were reported to have reading difficulties. In addition, both the children with strabismus who had and did not have low acuity had similar parental ratings describing their ease of learning to read.

We also wondered if strabismic surgical correction leads to fewer parental reports of reading difficulties. Eighty-two children with strabismus had strabismic surgical correction prior to the elementary school years. The parents reported that 41% of these children had reading difficulties, and the ease of their learning-to-read process was similar to the entire sample reported earlier and to those who did not have corrective surgery. In addition, we examined cases in which a postsurgery deviation remained. Overall, 36% of the children with postsurgery deviations and 44% of those with no postsurgery deviations were reported to have reading difficulties. Similar estimates of difficulties in learning to read were found between these two groups of children with strabismus. Finally, those with larger postsurgery deviations (more than 20 diopters) did not differ in the proportion who were reported to have reading difficulties from those with small postsurgery deviations (40% versus 38%).

Similar results were also found when we compared the reading difficulties of children with larger versus smaller deviations in the entire sample of children with strabismus.

Other academic difficulties

Figure 1 (the middle bars) illustrates that significantly more children with strabismus (49%) were reported to have at least one academic difficulty (not including reading) than were the control children (30%; Yates-corrected chi-square = 5.48, $p < .025$). Table 2 shows the percentage of children with nonreading academic difficulties by subject area. As a group, the parents tended to report these academic difficulties more frequently for their children with strabismus than for their children in the control group. However, these percentages did not differ significantly (all chi-square, $p > .05$), except in the area of physical education (Yates-corrected chi-square = 4.23, $p < .05$). Table 2 also illustrates that these academic difficulties were more frequently reported for the children with strabismus who had reading problems (all chi-square, $p < .005$, Bonferonni-type correction), except in the area of physical education. In physical education, the children with strabismus were reported to have more difficulties than were the children in the control group, whether or not they had reading problems. Finally, reports of other academic difficulties were not more prevalent in the children with strabismus who had low acuity, those with postsurgery deviations, or those with larger angle

deviations (all C_{95}, $p > .05$), except that those with larger postsurgery deviations did not have difficulties in physical education.

Nonacademic difficulties

Figure 1 (the bottom bars) shows that more children with strabismus (47%) were reported to have at least one nonacademic difficulty than were the children in the control group (8%; Yates-corrected chi-square = 22.08, $p < .005$). Table 3 indicates the percentage who were reported to have nonacademic difficulties by category. Significantly more children with strabismus than children in the control group were reported to stumble frequently, have difficulty catching balls, have headaches, and have eyestrain (all chi-square, $p < .05$). In addition, the children with strabismus and reading problems more often stumbled, had difficulty catching balls, had headaches, and had eyestrain than did the children with strabismus who did not have reading difficulties or the children in the control group (all chi-square, $p < .01$, Bonferonni-type correction). There were no differences in the visual conditions (acuity, refractive error, stereo acuity, deviation direction, angle of deviation, age at diagnosis) of the children with strabismus who had and did not have nonacademic difficulties (C_{95}, $p > .05$). Finally, reports of nonacademic difficulties were not more prevalent in the children with low acuity, those with postsurgery deviations, or those with larger angle deviations (all

$C_{95,}$ $p > .05$).

Discussion

Some parents reported that their children with strabismus and their children in the control group had reading difficulties. Observations of reading difficulties in the children in the control group are consistent with literacy rates in the province in which the survey was conducted (Education Quality and Accessibility Office, 2002; Statistics Canada, 1990). Overall, proportionally more parents of the children with strabismus reported that their children had reading, academic, and nonacademic difficulties than did parents of the children in the control group. In addition, the children with strabismus and reading problems were more often reported to have other academic (for example, mathematics) and nonacademic (for example, headaches and eyestrain) difficulties than were the children with strabismus who did not have reading problems. These difficulties were not well predicted by specific visual parameters (acuity, refractive errors, stereo acuity, angle of deviation, age at onset, and surgical correction). Furthermore, many parents did not report academic and nonacademic problems for their children with strabismus. This finding suggests that the presence of strabismus alone cannot be considered a marker for reading or other academic difficulties but that some forms of strabismus may be related to other underlying

factors that are associated with reading difficulties.

A number of researchers have found that many individuals with strabismus have other perceptual problems, such as difficulty with contrast (Levi & Harwerth, 1978; Reed, Steeves, Steinbach, Kraft, & Gallie, 1996), crowding (Rydberg, Ericson, Lennerstrand, Jacobson, & Lindstedt, 1999), eye movements (Kapoula, Bucci, Eggert, & Garraud, 1997; Reed et al., 1991; Steeves, Reed, Steinbach, & Kraft, 1999), motion (Reed & Burdett, 2002), and orientation (Reed, Steinbach, Ono, Kraft, & Gallie, 1995). Similarly, many of these studies did not find strong connections among visual acuity, refractive errors, and these perceptual abilities (Reed et al., 1991, 1995, 1996; Steeves et al, 1999; Reed & Burdett, 2002). Some researchers have suggested that some individuals with strabismus may suffer from neural noise—an uncalibrated disarray of cells—or a "noisy" visual system and that this neural noise is disruptive in performing perceptual tasks (Hess & Field, 1994). Such a noisy system may affect reading performance. An intrinsic problem with all these studies is that strabismus is treated as a homogeneous and independent factor, whereas there may be a variety of forms of strabismus and associated visual effects, and the role of more central contributing neurological difficulties may therefore not be apparent or may be difficult to measure.

We did not find that reading problems were well

predicted by age at onset (based on age at diagnosis). Many children with both early-and late-onset strabismus had reading difficulties. However, regardless of the age at onset, in the majority of cases, reading difficulties were resolved after the elementary school years. This finding may suggest that these children learn to adapt their reading situation or, as reading researchers have suggested, that reading strategies change with reading practice, when children no longer sound out individual letters but sight-read entire words or phrases (Just & Carpenter, 1987). It is possible that as children move from a focus on individual letters to a focus on entire words, fine visual discrimination and saccadic coordination are not as important to the reading process.

We also found that reading difficulties were no more prevalent in children with esotropia than in those with exotropia. This finding was surprising, given that some researchers have suggested that there is a link between poor reading and exotropia (see, for example, Snowden & Stewart-Brown, 1997). In addition, Von Noorden (1996) noted that persons with exodeviations often suffer from eyestrain, blurred vision, difficulties with prolonged periods of reading, headaches, and diplopia, but that children are often less symptomatic than are adults because of their well-developed suppression mechanisms. Thus, the similarity in academic and nonacademic difficulties between those with esodeviations and those with exodeviations may have been due, in part, to the age of the children in our

study.

Many children with strabismus who have reading difficulties also have difficulties with other academic areas. It is not surprising to find that children with strabismus who have reading difficulties also have spelling and language difficulties, given that many of them have trouble copying and with perceptual aspects (that is, crowding and contrast) of focusing on particular letters (Levi & Harwerth, 1978; Rydberg et al., 1999; Snowden & Stewart-Brown, 1997). In addition, studies of sighted children without strabismus who have dyslexia have shown that these children often have spelling and language problems (Just & Carpenter, 1987). However, in this study, we found that the children with strabismus and reading difficulties often had difficulty with mathematics and memory/attention. It is possible that some of these difficulties may be related to frustration. If these children have been frustrated with learning in general, they may be less motivated to learn.

One interesting finding was that many of the children with strabismus had a number of nonacademic difficulties that may be related directly or indirectly to the presence of the misalignment of visual axes. In particular, about one third of the children with strabismus who had reading difficulties were reported to have frequent headaches and eyestrain, whereas such problems were rarely reported for the children in the control group. Difficulties like eyestrain and

headaches could affect both academic and nonacademic activities in this group of children.

One limitation of our study was the reliance on parents' reports. Several sources of bias in parents' reports are possible. First, parents whose children were having academic difficulties may have been more likely than other parents to respond to our survey. However, many parents of children with strabismus did not report that their children had reading difficulties (62%) or other academic difficulties (more than 74%). In addition, our results are consistent with those of Woodhouse et al. (2000), who suggested that many children with dyslexia also suffer from strabismus. Second, parents' report may have been biased because the parents may have thought that their children's visual difficulty had to interfere with their children's academic performance. We think that such a bias was minimized by the fact that most parents used information from their children's report cards and interviews with teachers in answering the survey questions, and many parents of strabismic children did not report that their children had reading difficulties.

Many studies have shown that parents' reports are as accurate as standardized tests and professional opinion (Diamond, 1987; Gianatasio, 2001). Dewey, Crawford, and Kaplan (2003) found that the inclusion of parents' reports in educational assessment increased the correct identification of children with learning difficulties. Furthermore, Glascoe (1997) examined parents'

accuracy in identifying their children's cognitive abilities. Although she found that parents were able to identify disabilities 79% of the time, 28% of the parents identified an educational concern that was not apparent from the standardized tests. However, Glascoe found that the scores on the standardized tests of these incorrectly identified children were significantly lower (but within the low normal range) than were the scores for children who were identified as having no cognitive difficulties. She argued that these parents were not overly concerned but, rather, highly observant. Although Glascoe's results are encouraging, a comparison between children with and without strabismus on standardized tests of reading and grade reports would represent a logical next step in the understanding of the learning needs of children with strabismus.

Although the incidence of strabismus is higher in children with academic difficulties (Woodhouse et al., 2000) than in children without such difficulties, not all children with strabismus have academic difficulties. Thus, strabismus alone cannot act as a marker for learning difficulties; rather, other associated factors may have an impact on the learning of some children with strabismus. The importance of factors related to strabismus, such as differences in the processing of visual information, difficulties like headaches and eyestrain, or issues of frustration, require further exploration.

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